DOCUMENT RESUME

ED 254 261 JC 850 040

TITLE	Partners in Economic Growth: High Technology Industry and Postsecondary Education. The Report of the Task Force on High Technology.
INSTITUTION	Saskatchewan Dept. of Advanced Education and Manpower, Saskatoon.
PUB DATE	Nov 83
NOTE	38p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Educational Needs; Needs Assessment; *School Business Relationship; State Surveys; *Technical Education; *Technical Institutes; *Technological Advancement; Trade and Industrial Education; Two Year Colleges
IDENTIFIERS	Saskatchewan

ABSTRACT

An analysis is presented of the adequacy of Saskatchewan's technical institutes to satisfy the skilled labor needs of the emergent high technology industry. After section 1 summarizes the recommendations of the Task Force appointed to study the issue, section 2 offers a definition of "high technology" industries, looks at the effects of high technology on industry, and discusses implications for Saskatchewan. Section 3 offers guiding principles for the development of high technology in the province, focusing on the areas of agriculture, mining, communications, transportation, financial services, and medicine; reviews the growth of high technology in Saskatchewan; and provides information on high technology centers in the United States and Canada. In section 4, results are presented from a survey of high technology firms, indicating present industry characteristics, rates of growth and future needs, and high technology employment growth. Section 5 outlines the education requirements for entry-level employment and for continuing education, and discusses the need for greater public awareness. Section 6 assesses current high technology programs in Saskatchewan's technical institute system and provides comparative information about similar institutions in other areas. Section 7 identifies aspects of the postsecondary educational system that need to change in order to meet the needs of industry. Task Force proposals and recommendations are presented in section 8. Additional information on the employer survey is appended. (HB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
J. S. Scharf
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
X Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED254261

JC 850 040

Department of Advanced Education and Manpower
Hon. Colin Maxwell, Minister
November, 1983

HIGH TECH REPORT

2

TASK FORCE ON HIGH TECHNOLOGY AND POST SECONDARY EDUCATION PROVINCE OF SASKATCHEWAN

Partners in Economic Growth:

High Technology Industry and Postsecondary Education

The Report of the

Task Force on High Technology

presented to

Hon. Colin Maxwell
Minister of
Advanced Education
and Manpower

This report emerged from a collaboration of industrial and educational leaders. It deals with the challenge of managing our endeavors so that the emergence of high technology will bring new career opportunities and economic growth to the people of Saskatchewan

November/1983

November 1, 1983

The Honourable Colin Maxwell
Minister of Advanced Education
and Manpower
Legislative Buildings
Regina, Saskatchewan
S4S 0B3

Dear Mr. Maxwell

Last June, your predecessor, the Honourable Gordon Currie appointed a Task Force to examine and report upon the adequacy of post-secondary institutes to satisfy the skilled people needs of the emergent high technology industry in Saskatchewan. Fulfilling that mandate has been a very interesting challenge. We have enjoyed it.

Here is our report. I would like to stress four elements:

(a) It contains what might well be the first attempt to quantify the skilled people needs of our industry. We cannot be satisfied with its accuracy but it does provide a basis for planning. We urge you to ensure that the estimates are validated and extended annually.

(b) There is general satisfaction with the management of the qualification/accreditation programs within Saskatchewan's technical training institutes. A few suggestions for adjustment are included.

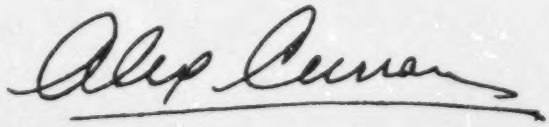
(c) There is a pressing need for a new method of managing the re-training requirements to support high technology industry. From our work has come the concept of a new branch of Kelsey operated as an open campus/open faculty venture in co-operation with industry We feel so anxious for this that the members of the Task Force are prepared to continue their involvement to flesh-out the concept if you so desire.

(d) Concern has been expressed about the transfer of credits from institutes of technology to the applied science programs of Saskatchewan's universities. We encourage you to establish a curriculum review process to ensure that academic recognition is achieved and that, through extension courses, a real possibility exists for technology graduates to progress to professional accreditation.

The members of the Task Force wish to express their thanks to Ron Clark who offered support from your Department, to Jack Scharf who opened our eyes to the capabilities of the technical institutes, and to Cheryl Van Blaricom who must have worn out several pairs of shoes in accumulating the evidence on which we could base knowledgeable proposals. Assistance less capable or less willingly given would have made our task much more difficult.

Finally, on behalf of all of the members, I would like to assure you that we have become even more impressed with the quality of the technical institutes, and enthusiastic about the opportunity to pioneer a new concept in co-operative management of the very difficult task of continuing re-education. We sincerely hope it will be possible to prove the concept here in Saskatchewan.

Yours truly



A. Curran
Chairman
High Technology Task Force

AC/gl

The Minister of Advanced Education
and Manpower's
Task Force on High Technology

Alex Curran (Chairman)
President, SED Systems

George Brown
Principal, Kelsey Institute

Ron Clark
Executive Director, Planning and Evaluation
Department of Advanced Education
and Manpower

John Cross
President, Philom Bios

Glenn Driscoll
President, Borealis Systems

Jack Scharf
Chairman, Program Development,
Kelsey Institute

Howard Tennant
Associate Dean, Graduate Studies,
University of Saskatchewan

Russ Woodland
General Manager, Optical Systems Division,
Northern Telecom

Researcher — Cheryl Van Blaricom

Table of Contents

	Letter of Transmittal	iii
	Task Force Members	v
	Table of Contents	vii
1.0	Summary of Recommendations	1
2.0	The Development of High Technology	3
3.0	High Technology in Saskatchewan	5
	3.1 Guiding Principles	5
	3.2 Agriculture	5
	3.3 Mining	5
	3.4 Communications	6
	3.5 Transportation	6
	3.6 Financial Services	7
	3.7 Medical	7
	3.8 Historical Growth	7
	3.9 Comparison With Other Technology Centres	8
4.0	Human Resource Skills	11
	4.1 The Role of Human Resource Skills in Industrial Development	11
	4.2 Survey Methodology	11
	4.3 Characteristics of the Present Industry	11
	4.4 Rates of Growth and Future Needs	12
5.0	Educational Requirements	17
	5.1 Entry Level	17
	5.2 Continuing Education	17
	5.3 Public Awareness	18
6.0	Assessment of Current Programs	19
	6.1 High Technology Programs in the Saskatchewan System	19
	6.2 Comparison With Other Systems	20
7.0	Managing for Adaptability and Flexibility	21
8.0	Proposals and Recommendations	23
	Appendices	27

1.0 Summary of Recommendations

#1 That the Government of Saskatchewan ensure that, to the extent possible, the future high technology growth and development be concentrated in Saskatoon.

#2 That the Department of Advanced Education and Manpower should establish two training streams at the Kelsey Institute of Arts and Sciences: the current accreditation stream and a new continuing education or re-training stream.

#3 That the Department of Advanced Education and Manpower should terminate the existing one year technician chemical and electronics programs, to be replaced by redesigned two year programs in the following areas:

Electrical Engineering
Chemical Engineering
Computer Technology
Microcomputer Technology

#4 That the Department of Advanced Education and Manpower establish a new High Technology continuing education unit or facility within Kelsey Institute.

#5 That the Department of Advanced Education and Manpower undertake a comprehensive review of how current institute-based credit training is evaluated and recognized as entrance and/or prerequisites in the province's universities.

#6 That post-secondary educational facilities including Kelsey explore new and innovative means of sharing equipment, facilities, and faculty.

#7 That Government and industry expand their collaborative role in informing the public about the future of science and technology in our daily lives.

#8 That the Department of Advanced Education and Manpower continue to review and monitor the data and statistical analysis contained in this report.

#9 That the Government of Saskatchewan establish an industry/government advisory council to further the opportunities for ongoing dialogue, advice, and participation into public policy considerations affecting the high technology industry in Saskatchewan.

#10 That the Department of Advanced Education and Manpower establish a formal high tech industry-institute council at Kelsey Institute to pursue the suggestions and recommendations of this Task Force and to explore new opportunities for strengthening the interface between Kelsey Institute and the high technology community in Saskatoon.

2.0 The Development of High Technology

High technology industries are those whose products and services are characterized more by the innovation than the materials embodied in them. It is difficult to define precisely what constitutes the industry. However, the United States Bureau of Labor Statistics (Business Week, March 28, 1983) classifies as high technology any industry in which research and development (R & D) expenditures and the number of technical employees are at least twice as high as the average for all manufacturing businesses. By that definition only 36 out of 977 standard industrial classifications qualify as "high technology."

The classification is small. In the United States it accounted for only three percent of employment in 1979. Although it is a fast growing segment of industry, its employment base in the United States is expected to grow to no more than four percent of total employment by 1993. In Canada the percentages are certainly no higher.

If "high tech" were an industry unto itself, it would merit no special consideration since its direct employment impact is so small. However, it is not an industry unto itself. It is an industry which has produced dramatic improvements in material, employment and information productivity; and, as a consequence, it impacts all other industries.

The primary example today is electronics. It is now 35 years since the invention of the transistor. For ten of those years 'solid state' was little more than a laboratory curiosity as scientists learned how to make the devices and how to use them to replace vacuum tubes. In the succeeding quarter century those solid state devices have penetrated deeply into our society, and by doing so have produced very significant changes. Thus, solid state electronics has brought about the following:
— changed dramatically such established industries as broadcasting, telecommunications and transportation.
— created totally new industries in entertainment, data processing and information services.
— altered irrevocably the disciplines of management, engineering and accounting.
— shifted the production centres for consumer electronics from North America to Asia.
— moved the centre of industrial growth in the United States from North-east to South-west.

Clearly, such massive changes cannot be ignored.

After 35 years of solid state electronics, it is possible to draw some conclusions about involvement in high technology industry:

— the rate of penetration of electronics has been very rapid. Disciplines have changed in a time span much shorter than the career life of an individual. Consequently change and retraining are necessary.
— productivity improvements engendered by applications of electronics have enabled some companies to expand, while others slow to adapt have faltered. It seems important, therefore, for a community to be aware of the new technology even if only to protect its economic base.
— electronics has proven to be a global industry. Companies and communities which have succeeded have done so by attacking successfully the world markets.
— to succeed, a pool of people is required, knowledgeable in the technology and attuned to the related developments in other countries.

Saskatchewan is not shielded from these effects. A high technology industry is needed as a growth sector in its own right, and as a nucleus from which to promote improvements in productivity for other industries. A start has been made. An embryonic high tech community has emerged in Saskatoon, centred primarily on telecommunications applications. Other thrusts such as bio-technology are possible. As new examples of high tech emerge, Saskatchewan can choose which fields to promote.

This report is concerned with the s'illed per-

sons who will be needed to participate in the development of a Saskatchewan based high technology industry. Predictions of human needs require both a definition of the fields to be developed and forecasts of the people required at various definable skills levels. In turn that demands an insight into the areas likely to mature into new industries in the near future, and a selection from those of the fields in which Saskatchewan has natural advantages, hence a good chance for success. That discussion is contained in the next section of this report. Thereafter, an attempt is made to estimate the number of skilled people required for the industry, and finally the report addresses the problems of managing the training needs.

3.0 High Technology in Saskatchewan

3.1 Guiding Principles

Saskatchewan has a small, vibrant high technology industry. Its current base is the telecommunications market; however, there is additional strength in scientific instrumentations, mining applications, life sciences and agricultural sciences.

Choices must be made with respect to concentration of effort and exploitation of opportunity. Clearly the industry should be broader than electronics alone, otherwise the risk of total failure is high. Equally clearly, Saskatchewan's small population and economic base dictate that resources should be concentrated where there are natural advantages which give Saskatchewan industry a better than average chance for success.

In its exploration of the areas likely to be productive, the members of the Task force identified six fields in which high technology applications could be encouraged. The members concluded also that to pursue six areas concurrently would likely lead to dissipation of effort with potential risk to all sectors. At least initially, therefore, we suggest that resources be concentrated in the areas of agriculture, mining and communications.

3.2 Agriculture

Agriculture is the historical and commercial foundation of Saskatchewan. While often perceived as a low technology industry, agriculture is increasingly based on technological developments in seeds, fertilizers, herbicides and pesticides, farm planning, food processing, and other related developments.

Saskatoon is a major seed development centre. Canola is perhaps the best known development, but ongoing research is also proceeding on wheats, barley, peas, lentils, fababean, sunflowers, and mustard.

Fertilizer, herbicide, and pesticide requirements and optimum utilization, electronic monitoring devices, environmentally compatible bio-insecticides and bio-herbicides, and crop treatments to resist early frost are high technology applications to agriculture with considerable potential. Equally attractive is the prospect of a province-wide agricultural information system programmed to help farmers in planning their business, through analysis of such relevant data as crop history, soil conditions, options for soil treatment, market factors, transportation costs, labor availability and costs of money. A small start in this direction has already been made via Project Grassroots which, although admittedly embryonic, is achieving increasing farmer acceptance in Manitoba.

Food processing is a vital provincial industry. Oil seed crushing is particularly prominent, and produces meal, vegetable oil, and margarine. Other agricultural potential lies in the development of alternative fuels from grains and screenings, insect control through pheremones, waste heat utilization, zero tillage, and other similar developments.

3.3 Mining

Mining is Saskatchewan's second largest industry and constitutes, for the purposes of this report, coal, oil, natural gas, potash and uranium. These products sell on the world market; therefore, international competitiveness with other producers is imperative. Productivity has increased in mining as extraction evolved from muscle to machine power, and the industry is currently moving towards a further increase through the application of electronics.

In the oil industry, computer analysis of drilling experience in the region has been used to reduce the time of drilling a potential well from ten to seven days at a saving of approximately

$30,000.00. In the extraction of heavy oil, enhanced recovery techniques such as the injection of steam into the ground or the use of underground fires, will be required to mine most of the heavy oil which still lies beneath Saskatchewan. In the coal industry, unpredictable rock behaviour can make underground mines too dangerous for workers. Remotely controlled equipment is now able to extract the coal from these previously unusable sites. These examples are illustrative of the utility and the need for high technology in mining in Saskatchewan.

One of the key issues for all sectors of mining is the percentage of ore which can be extracted. For example, 99% of the heavy oil in Saskatchewan is still in the ground, and the extraction of most of this will require the application of new technology. The development of microbrial systems to promote enhanced oil recovery may have considerable potential. In the potash industry, current technology allows for extraction of approximately 40% of the ore. The industry goal is 100% extraction and this will require complex electronic sensing devices.

International competitiveness, productivity, and growth of the mining industry over the remaining years of the 20th century will be primarily a function of the application of high technology to this industry. This process is already under way to a limited degree, and will likely accelerate over the next decade.

3.4 Communications

The telecommunications industry is a prime example of the power of bold procurement decision to create an industrial presence.

Several years ago, officials of Sask. Tel made a commitment to build a fibre optics network to link the 52 largest population centres. This was a high risk decision: it was the first large scale commitment by a utility to fibre technology. Because it was a first, it was possible to persuade Northern Telecom to construct an optical fibre factory in Saskatoon and to relocate the R & D effort to that city. Northern has since won contracts many times larger than the original Sask. Tel order, and as a result has provided employment for 400 people with plans already in place to expand to 600 people. Sask. Tel's risk decision has paid off handsomely for Northern and for the province.

Saskatchewan's search for a solution to its problem of a small population spread throughout a large area has also given birth to other telecommunications-based companies particularly in the areas of satellite communications, data communications and television distribution. It is a growth area in which there is already an established widely-recognized expertise.

3.5 Transportation

Transportation is a critical industry in Saskatchewan. With grain, potash and other products being marketed around the world, effective and efficient transportation is required.

Perhaps more than any other province, Saskatchewan's development is linked to the railroad. Indeed, the West as a whole became populated as a result of the construction of the Canadian Pacific Railroad a century ago. High technology has considerable applications in rail transportation, such as road bed and bridge construction, signal and communications systems, and train design and assembly. It is clear, however, that Saskatchewan has no unique opportunity to exploit in this area, with one exception. Handling and transportation of grain has lagged behind other commodities such as coal, potash and lumber where advanced technology has made a significant impact. With grain remaining a significant export product, and with the federal government encouraging long term increases in grain production in Western Canada, a significant opportunity

exists in high technology applications to moving Saskatchewan's grain.

Opportunities for the application of high technology in roadway facilities appear to be similar to that of rail transportation in that they involve design and maintenance of road beds and bridges, traffic signals, communications, and scheduling/routing. A key difference, however, may lie in the control of these systems. Unlike rail transportation, much of roadway transportation is within provincial or even municipal jurisdiction. As in the case of Sask. Tel's fibre optics decision, this element of local control could help in the application of high technology in this industry.

3.6 Financial Services

Saskatchewan is in the vanguard of high technology developments in financial services. For example, with over 1,500 automated tellers and administrative terminals spread across 60 institutions, Saskatchewan has perhaps the highest use of telectronic banking facilities anywhere in North America. Further developments such as satellite communications could allow isoiated northern communities to have the same banking services as the larger urban centres.

These developments are at least partially a function of a population density which is among the lowest in the world. While the initial application may be provincial, it is expected that resulting technologies may be marketed world-wide, particularly in the United States and Europe. Continued development of this technology is highly dependent on trained personnel in research and development, production, maintenance and repair, and operation.

3.7 Medical

Saskatoon is the medical centre of Saskatchewan and one of the few centres in North America to have a complete set of health sciences: medicine, dentistry, nursing, pharmacy, and veterinary medicine. The Veterinary Infectious Diseases Organization and numerous medical clinics provide a substantial employment in health care and research.

Major technological changes affecting health care have been modern techniques for storing and retrieving information, transmitting information, automatic diagnostic procedures, and laboratory tests. Computerization of hospital management and administration is only beginning to be fully exploited.

Future developments include diagnostic products by bio-technology companies. The monoclonal technology required is relatively inexpensive, represents a fast growing segment of the total drug industry, and is subject to less regulation and testing than other aspects of the drug industry.

3.8 Historical Growth

The University of Saskatchewan has been the creator of high technology in the province for many years. That role seems to be almost a natural consequence of the University's policy of support and relevance to the community. Perhaps the first specific example of industrial spin-off was the development within the Department of Chemistry 50 years ago of alkali-resistent concrete. Although this was a development of major importance to the province, the industrial impact went elsewhere. In agriculture the contributions of the Department have been instrumental in maintaining a healthy agricultural industry through decades of change in soil conditions, market factors, cost implications and labor adjustments. More recently the Department of Physics, through its Institute of Space and

Atmospheric Studies, extended the process from recognition of an opportunity to actual creation of a high technology company.

SED Systems was launched in 1966 as Saskatoon's first step into high technology. SED Systems is now a major firm competing in international markets. Its growth has led to the creation of a second generation of firms started by its own former employees. These include SCI-Tec Instruments, CL Blue Systems and Strother Satellite Systems.

Major Canadian firms such as Northern Telecom and AEL Microtel have developed large operations in Saskatoon. Develcon is another high technology company. Smaller firms such as Borealis Systems and Advanced Data are obtaining large national and international contracts. Saskatoon is a leading bio-technology centre in Canada; POS Pilot Plant, Vido, Pro Star Mills, Philom Bios, and National Research Council's Plant Bio-technology Institute, Agriculture Canada's research station and the College of Agriculture are all vigorous bio-technology operations.

3.9 Comparison With Other Technology Centres

It is possible through comparisons with other high technology centres to evaluate our aspirations to establish such a centre in Saskatchewan, and to assess the support necessary to enable the centre to grow from the existing base to a stable, self-sufficient community. For our purposes, the most meaningful comparisons are four centres:

— the San Francisco Bay Area (Silicon Valley), California
— Route 128, near Boston, Massachusetts
— Triangle Park, North Carolina
— Kanata, Ontario

Silicon Valley is the prototype high technology centre. Its genesis was in the years immediately following World War II, when Dr. Frederick E. Terman, Dean of Engineering, Stanford University, persuaded some of his graduate students to stay in California to establish new electronics companies rather than joining the existing companies in the north-eastern states. Within 25 years, the community which grew from the Stanford campus had essentially supplanted the eastern seaboard as the centre of activity in electronics.

In its growth stage, the high tech community depended to a great extent on support from Stanford. By the late 1960's, direct dependence had decreased because several companies had achieved international success, and the technical community was sufficiently large that professionals freely chose to pursue their careers there. Thereafter, the rapport with Stanford changed to that of a partnership with both university and industry receiving benefits.

While many factors contributed to success, the critical factors for Silicon Valley were that Stanford University acted as the initial nucleus and that local capital emerged to provide a start for the pioneers. By the late 1960's, the following signs of success were observable:

— the process of company creation by "fission" from existing companies was well-established;
— a few companies had achieved international prominence;
— the professional community in industry was sufficiently large that others were prepared to join without salary premiums.
— By the 1970's, the relation with Stanford had changed to one of partnership with the University benefitting from contributions made by industry.

By contrast the experience of Route 128 was less successful. It began at the same time as Silicon Valley and might have been expected to advance more rapidly. At that time the Massachusetts Institute of Technology was more prestigious than Stanford, industry was well-established in the Boston area, and Boston was a very desirable community in which to live.

And there was success, but not as brilliant as in Silicon Valley. The reasons for relatively poorer results include:

— New ventures along Route 128 tended to be R & D dominated, apparently depending on established industry to adopt the results of research. In California a new industry was created optimized for the emerging technology.
— In the 1960's, the quality of life in Boston deteriorated. It became a less than desirable place to live.

Thus it seems necessary for success to create a total industrial process—from R & D through manufacture to sales—in a community in which family life can be enjoyed.

Triangle Park came later. North Carolina traditionally has been one of the less developed states. In the early 1970's, a political decision was taken to develop an industrial thrust in high technology. That thrust consisted of three essential ingredients:

— A determination on the part of local universities and technical colleges to support high technology industrial development in a manner comparable to that of Stanford;
— A government program of incentives to electronic companies to establish themselves in the Park;
— A determined attempt to encourage major electronics companies to establish subsidiaries in the Park.

The efforts have been successful. The community is now well-established. What began as a branch plant area has now developed to the point at which significant R & D is also performed in the Park.

Finally, in Kanata some of the same thrusts can be observed. However, for our purposes, Kanata is even more instructive since some quantitative comparisons can be made.

The nucleus for Kanata is Bell-Northern Research established in 1960. Second generation companies such as Epitek and Mitel began to emerge in 1974. The high technology community was well-established by about 1980 when the professional industrial group numbered about 2,000 people, when some second generation companies had achieved success and when third and fourth generation companies were appearing. Unlike Triangle Park, the Kanata operation grew from the nucleus of an industrial R & D centre. Its industrial base grew initially primarily from the generation of new companies, partly from the attraction of branch plants from other already established companies.

In summary, it would appear that there are at least two critical elements:
— The time to nurture a high technology centre to reasonable maturity is 20 to 25 years;
— Initially some nucleus is required to assume leadership in attracting people and organizations. The nucleus may be a university (e.g., Stanford, M.I.T.) or a company (e.g., Bell-Northern Research).

As an embryonic high technology centre, Saskatoon currently employs only about one tenth the number that work in Kanata, as can be seen in the comparison below:

High Tech Centre Comparison

	Kanata*	Saskatoon**
Number of Companies	360	55
Number of Employees	25,000	2,478

*Financial Times of Canada, August 29, 1983
**Data collected by Task Force

Table I

What are the lessons to be drawn from the experience of the high technology centres in Silicon Valley, Route 128, Triangle Park, and Kanata and, more specifically, what application do they have to Saskatchewan? The first and overriding lesson is that geographical concentration is required. Success as a high tech centre is assured only after a critical mass has been achieved. Saskatoon has not yet reached that mass; therefore, until it does, the entire focus of high technology in the province of Saskatchewan must be directed towards the establishment of a high tech centre in Saskatoon.

The second lesson to be learned is that careful nurturing of an embryonic high tech centre is required. In Saskatchewan, this nurturing will have to be sustained for the rest of the 1980s. It will require a number of elements:
— an available pool of trained personnel
— continued R & D efforts from the University of Saskatchewan
— a cultural and educational capacity to retrain and upgrade technologists.

An established high tech centre has a self generating body of at least 2,000 technologists and engineers. Saskatoon is but one quarter of the way to this critical mass.

4.0 Human Resource Skills

4.1 The Role of Human Resource Skills in Industrial Development

The availability of skilled personnel is always a critical factor in industrial development, along with finance, market, raw materials, transportation, and other factors. In the knowledge or information industries, personnel is more than just one of the major factors. Personnel is the critical factor.

In a study of 691 firms entitled "Location of High Technology Firms and the Regional Economy" recently prepared by the Joint Economic Committee of the United States Congress (Industrial Development, July/August, 1983), it was concluded that the most important factor for high technology firms was the availability and cost of skilled labor. (Ranking next was the tax structure and the third most critical factor was accessibility to qualify universities and technical institutions.) The conclusion that trained personnel is the imperative issue has been made a number of times in other studies. Magaziner and Reich, in *"Minding America's Business"* (Random House, 1982) observed

> *new industries often develop in geographic areas where a 'critical mass' of new skills has been created.*

Recognition of this factor was a significant factor in the development of Triangle Park in North Carolina. Due to close collaboration between educational institutions and industry, graduates of technology programs were emerging from educational institutions at the exact time that industry was beginning to recruit staff with these skills.

4.2 Survey Methodology

The data appearing in this report has been obtained by means of structured personal interviews conducted during the period of June to September, 1983. Twenty-two private and 13 publicly funded high technology firms participated in the formal structured interview process. The privately-owned firms include the mining industry as well as the Prince Albert Pulp and Paper Corporation, as growth in these industries is closely tied to market demand rather than government policy. A complete list of those participating in the structured interview process appears in Appendix A.

In addition to the 35 structured interviews with employers, the Task Force interviewed 37 additional sources involved in high technology. These included many individuals who have a significant impact on Saskatchewan's high technology industry. A complete list of those interviewed appears in Appendix B of this report.

The Industrial Development Branch of the City of Saskatoon currently lists 55 firms classified as high technology and located within the city. The survey data includes 30 of these firms, six Regina based organizations, and the Prince Albert Pulp and Paper Corporation. Although time constraints limited the number of firms which could be interviewed, those consulted represent more than 90% of total high tech employment within the province.

4.3 Characteristics of the Present Industry

Saskatoon is home for almost the entire private sector of Saskatchewan's high technology industry. Regina maintains a significant proportion of high technology positions resulting from employment opportunities available through Saskatchewan Telecommunications Corporation and Saskatchewan Power Corporation. These two companies currently account for more than half of all high technology jobs in the province. Table II provides a summary of the high technology labor force as it currently exists in Saskatchewan. (Appendices C and D display the raw data collected in the survey.)

Current Labor Force

	Public Sector	Private Sector *	Total
Total Number of Employees	8,105	2,454	10,559
Number of High Technology Employees			
Full-time	3,196	1,341	4,537
Part-time	75	39	114
All Other Employees	4,834	1,074	5,908

*The mining industry and the pulp and paper industry are assumed to be in the private sector as their growth and projected manpower needs are tied to the market demand for their products.

Table II

Some existing firms have not been included in this data. These are small, privately owned companies having few employees. In aggregate, it is estimated that these employees would total less than 200.

In addition to those directly employed in high technology, the industry employs many support staff, and has a significant impact upon other industries within the community. While it is true that the growth and development of high technology may result in some job changes and the need for retraining, it also provides a stimulus and a driving force, not just for its own industry base, but also to attract spin-off industries.

At present the largest proportion of people working directly in this industry are classified as "layworkers", having had no recognized formal training in the high technology area. The crown corporations have a larger percentage of layworkers at present than does the remainder of the industry. The breakdown of "layworkers", "technicians" (one year high technology training), "technologists" (two years high technology training), and "professionals" (four or more years high technology training) is shown in Table III. The figures show the largest numbers of employees to be layworkers, followed by professionals, technologists and technicians.

The largest portion of the high technology industry presently exists in the electronics and biotechnology areas, followed by data processing and then by machine design and control. The remaining areas are so diverse that it is difficult to categorize them in any way. The complete breakdown by area of interest is illustrated in Table III. It should be noted that there is no public sector in the machine design and control area.

During the survey, respondents were asked for their comments on the adequacy of existing sign and control area projects startling perare not necessarily germane to the critical aspect of our work but may provide guidance to Kelsey Institute and to the Department of Advanced Education. Therefore, we have listed the more serious observations in Appendix E.

4.4 Rates of Growth and Future Needs

Predicting growth in any industry is problematic, particularly in young developing high technology industries. Budding industries often experience difficulty envisioning potential growth rates having had little experience upon which to base their predictions. Predicting the growth of a developing industry is not simply a matter of charting the growth of existing companies. Attrition of these companies and the development of new companies are major factors to be considered if accurate forecasts are to be made.

The high technology industry is very polarized in terms of public/private sector growth expectations. In fact, Saskatchewan's public sector high technology market is predicting little or no growth within the upcoming five year period. The private sector, on the other hand, is predicting a near doubling during the same period.

Current Labor Force by High Technology Category

Category	High Tech Employees						Support Staff	Total Labor Force
	prof-essional	techno-logist	technician	other	lay-worker	total		
Electronics								
private	282	169	35	0	368	854	379	1,233
public	424	552	119	7	1,556	2,658	4,828	7,486
total	706	721	154	7	1,924	3,512	5,207	8,719
Data Processing								
private	60	13	18	0	50	141	0	364*
public	19	0	1	0	10	30	2	32
total	79	13	19	0	60	171	2	396
Biotechnology								
private	9	9	1	2	5	26	21	47
public	227	143	12	61	77	520	38	558
total	236	152	13	63	82	546	59	605
Machine Design and Control**								
private	30	12	17	12	65	136	236	372
public								
Other	23	13	16	0	82	134	333	467
Totals	1,074	911	219	82	2,213	4,499	5,837	10,559*

*Includes 223 employees in one firm which could not be categorized
**An entirely private sector industry

Table III

In total the present private sector industry is predicting a 93% increase in total staff over the next five years.

The present electronics and biotechnology industries expect that the number of professionals and technicians will experience the greatest levels of increase. Data processing predicts the largest increase in professionals, technologists, and technicians respectively. The machine design and control area projects startling percentage increases in the number of machinists, and technicians required, but it must be remembered that there are few people presently working in this sector. A predicted increase of 26 technicians constitutes a 153% increase over those presently employed.

A breakdown of trained high technology staff required in 1988 in each of the specific categories is shown in Table IV.

Today the public sector is the largest high technology employer in the province: 8,105 employees of a total of 10,559. However, that dominance is changing. Nearly all public sector institutions are part of a restraint program which will limit growth over the next decade. We have assumed zero growth in the public sector over the next five years.

Projected Additional Trained Staff Required In 1988 — Currently Existing Firms

	tech-nician	tech-nologist	profes-sional	other
Electronics				
private	30	65	131	0
public	1	8	4	0
total	31	73	135	0
Data Processing*				
private	5	17	95	0
public	0	0	20	0
total	5	17	115	0
Biotechnology*				
private	10	10	17	0
public	5	48	49	0
total	15	58	66	0
Machine Design and Control**				
private (total)	26	10	27	32
Other	25	8	6	0

*The Task Force believes the figures in Data Processing and Biotechnology dramatically underestimate the growth in these fields.
** An entirely private sector industry.

Table IV

By contrast the private sector is small, but growing. Current employment is 2,454 but confidence in the future is strong. The established companies fully expect to double the number of employees over the next five years.

However, even this does not fully recognize the growth potential of the industry. New companies are emerging rapidly in Saskatoon. Had a survey been taken five years ago, projections based on firms in operation then would have missed completely the emergence of almost one-third of today's employment opportunities.

We fully expect that the process of new company formation will continue both through the birth of new local companies and through the attraction of divisions or branches of existing national or international corporations. Thus, given the results of the survey, our expectation is that employment in existing companies will grow from nearly 2,500 to about 5,000 by 1988. In addition new private entrants will create new job opportunities so that the total private sector employment will reach approximately 7,200 by 1988. Thus, we have estimated high technology employment growth as follows:

High Technology Employment Growth

	1983	1988
Public Sector	8,105	8,105
Private Sector	2,454	7,200
Total	10,559	15,305

Table V

Even this may be conservative when the following are considered:
(a) The impact of biotechnology is almost certainly underestimated in our figures. Currently, the private sector is very small with the public sector acting as catalyst for growth. Our assumption has been for zero growth in the public sector. In biotechnology, we hope that this assumption is incorrect, otherwise Saskatchewan will miss a unique opportunity to create a new industry to complement the present agricultural base.

(b) The estimate for growth in computer related careers is also underestimated. In our survey we concentrated on high technology firms. The process of computer dissemination to traditional industry is already established and will gain momentum during the next year. We cannot estimate the employment impact because of the limitations of our survey.

Nevertheless, even when employment potential in two major high technology fields is underestimated because of limitations in our survey, the major need by industry is less the pre ser-

vice training for new employees than it is the in service training of existing employees. To remain competitive in world markets, as Saskatchewan's high technology industry must, requires steadily increasing productivity. Productivity improvements are to a considerable extent dependent on the utilization of state-of-the-art equipment, and staff working with such equipment must be regularly upgraded. Thus, the highest priority of this Task Force is in continuing education. This position will be further developed in the following chapters of this report.

5.0 Educational Requirements

Basic educational requirements for entry into the high technology industry are not expected to change drastically from those of today. It can be clearly stated that in order for individuals to gain employment in Saskatchewan's high technology industry, they must continue to obtain training at the technical institute and university levels. Two year technology diplomas and university degrees will continue to be utilized as basic educational requirements for entry into the trained manpower section of the high technology industry. However, the Task Force does not believe that the current accreditation training and professional education patterns are adequate to meet the future personnel requirements of the high technology sector.

5.1 Entry Level

The major requirement for change in accreditation programming involves increasing the current Chemical Technician and Electrical/Electronics Maintenance and Repair Programs from one year to two year programs. These programs, plus two year programs in biosciences, microcomputer management and computer technology are expected to comprise the standard accepted core of educational training for individuals interested in technical positions within the high technology industry.

At the professional level, computer science, electronics, physics, and chemical and mechanical engineering degrees will continue to be utilized as recruiting standards. Degrees in power engineering and engineering communications have been suggested as desirable additions to the list of basic degrees being recruited, should programs of this nature be established at the university level. Graduate degrees in specialized areas such as electrical and communications engineering, computer science, toxicology, and advanced microbiology will be escalating in demand as Saskatchewan's high technology industry develops.

5.2 Continuing Education

A major area of concern of high technology industry is that of post-secondary continuing education. At present there is an extreme shortage of programs and courses by which employees of high technology firms can upgrade their skills and knowledge in computer science, engineering and science related study while maintaining their jobs on a full time basis in industry. Access to post-secondary institutions is limited by the high enrollment of these institutions and by programming which is geared to the full time student. It is the current feeling that not only is there a complete lack of programs set up to help employees keep current or upgrade specific skills, but there is also a lack of up-to-date equipment in educational institutions upon which to provide continuing education programs at the leading edge of technology.

Many employers, particularly in the public sector, expect to hire few new employees. However, nearly all employees, public and private, have identified needs to update the skills of current staff. Short courses not necessarily requiring formal accreditation standards are required in many sectors of the high technology industry.

Topics such as basic computer orientation, first-line management skills, principles of CAD/CAM, and integrated circuitry are just a few of the topics which today's industry views as deserving of continuing education programs.

The emphasis in this area must be on responsiveness. High technology is a fast moving industry in which rapid changes greatly affect operations within the industry. It is essential that educational institutions wishing to meet the demands of the market be responsive, flexible, and creative in their approach to programming. They must be able to design and launch programs tailored to the needs of industry rapidly, ideally within one month.

In order to facilitate responsive programming, co-operation between industry and institutions is essential. The utilization of up-to-date equip-

ment existing in industry is necessary to provide meaningful practical experience in an educational setting. The cost of keeping such equipment current is often beyond the resources of today's educational institutions. There may also be areas of training where the availability or expertise of industry personnel makes them most desirable as instructors of short courses on high technology topics. The sharing of resources (human, equipment, and facilities) by industry and educational institutions would enable the development of a process designed to be directly responsive to the needs of the high technology industry.

5.3 Public Awareness

The final area of concern in the education field is that of public education. Public awareness and the promotion of Saskatchewan's high technology industry is important in maintaining a healthy, vibrant industry which will continue to grow and attract quality industrialists and educators. Sound programs promoting Saskatchewan's high technology industry provide spin-off benefits for the community as a whole.

High school programs designed to generate awareness and interest in high technology should be encouraged. Awareness of high technology careers will attract capable young people into relevant training programs.

Many factors affect the development of a young industry. Promotion of the benefits of science and technology will help to provide the support and encouragement needed to build a dynamic industry. Enthusiasm breeds enthusiasm, which attracts key people and businesses needed to nurture the existing high technology environment.

6.0 Assessment of Current Programs

6.1 High Technology Programs in the Saskatchewan System

The technical institute system in Saskatchewan offers a number of programs which could be classified as high technology. In some, the high technology element is currently minor, such as where machine shop students are made aware of developments in computer numerical control and have a few hours of practical experience on such a piece of equipment. For the purpose of this report, high technology programs are those which devote some significant part of their curriculum to high technology and which have two years of training, usually of approximately 2,400 hours total program content. In these programs, there are usually three to five qualified applicants for each available space.

Current Programs

Institute	Program	Annual Number of Graduates
Kelsey	Biological Sciences	30
Kelsey	Mechanical Engineering	35
Sask. Tech. Institute	Electronics Engineering	30
Sask. Tech. Institute	Data Processing	25
Sask. Tech. Institute	Computer Engineering	30
		140

Table VI

As well, there are one year programs with high technology content such as Chemical Technician, Electrical and Electronics Maintenance and Repair (EEMR), and Microcomputer Management at Kelsey, Telecommunications at Wascana, and Industrial Instrumentation at S.T.I. Despite limitations, due to program length, the EEMR program at Kelsey had its intake expanded from 18 to 54 in its second year of operation. The Micro-computer Management Program began this year with an intake of 36.

Furthermore, approval has been given to the Department of Advanced Education and Manpower for four programs of sixty-five weeks in length: robotics, electronics engineering, data processing, and electrical engineering. Each of these programs is projected to produce about 12 graduates.

With some exceptions, existing programs are operated on a traditional basis. There is little or no provision for open entry and exit, part-time students, learning on the job, recognition for prior non-credentialed learning, or modularized programming. Some of these elements are being planned, particularly modularization and competency-based learning, but only on a limited scale.

Graduates of two year post-secondary programs geared to high technology industry should expect to be able to interface with other established three and four year post-secondary programs of study on a continuing education basis.

It was the strong feeling of the Task Force that graduates of technical school programs of high technology subjects should be able to enter programs of study at the university level with advanced standing. While the Task Force recognized that total portability of course work taken at a technical institute would present considerable problems, it was the strong view of the Task Force that substantially better program interfaces could and should be developed between the province's technical institutes and universities. Such interfaces should include the provision of evening course work and appropriate counselling of students by both types of institutions.

6.2 Comparison with Other Systems

The continuing education capability of technical institutes in Saskatchewan can be compared to similar institutions in other areas. In this regard, two Task Force members visited Algonquin College and Kanata High Technology Training Association in Ottawa and Lorain County Community College, just west of Cleveland, Ohio.

Algonquin College is the largest two year institution in Ontario and offers seven three-year and nine two-year programs and three more of one or less than one year duration. It is judged by local industry to be doing a good job of training technicians and technologists. However, Algonquin is perceived by some to be insufficiently responsive to upgrading and short term training needs. This contributed to the development of the Kanata High Technology Training Association, a consortium of seven of the region's larger firms. The function of the Association is to provide upgrading for staff of member firms through the provision of specific and highly focused training sessions. The Association was funded by $2.5 million from the Skills Growth Fund of the federal government.

The Lorain County Community College High Technology Training Centre is similar to the Kanata High Technology Training Association in primary purpose. Both the Association and the Centre are designed to meet the upgrading and specific training needs of high technology firms in the region and are able to make programming decisions within four weeks in accordance with industrial demands. The Lorain Centre has a mandate which emphasizes training and upgrading but which goes beyond that. This Centre has a public education dimension in responding to the needs of the unemployed and also serves as a vehicle for promotion of the region's industrial potential.

The Lorain Centre is part of a public two year institution much like Kelsey Institute. Recognizing that such a centre could not function within a typical bureaucratic structure, the Board of Lorain County Community College created an entity which is independent of union restrictions, standard personnel recruitment procedures, course and program approval mechanisms, and other impediments to responsiveness. This dramatic departure from established practice has been accomplished with minimal organizational stress, primarily as a result of a workable structure and of strong leadership from the senior administration and board of Lorain County Community College.

7.0 Managing for Adaptability and Flexibility

The work of the Task Force has led to the firmly held conclusion that there are several aspects of the post-secondary educational system which must undergo significant change if the system is to play a meaningful role in a dynamic industrial sector like high technology.

It is our view that the current program development process is ponderous and that delivery is inflexible. This pattern may fit the needs of the formal accreditation programs which demand consensus on curriculum planning and approval, appropriate staffing, industry liaison, and inter-provincial recognition of certification. However, inasmuch as credit training is the prevalent activity currently operating in the province's technical institutes, we doubt that this approach, acknowledged as essential and legitimate, is sufficient by itself to meet the needs of the high technology sector.

A second need is for retaining and upgrading. In this regard, "responsiveness", "flexibility", "entrepreneurial", and "partnership" are words which should characterize the education/high technology training interface. While not singularly unique to the high technology sector, the continuing education requirements are such that they typically require a much more flexible and adaptive training response. The following are examples:

— Often the training needs of industry are immediate and not amenable to lengthy, institutional planning/budgeting processes.
— Usually the training requirement is very industry or equipment specific.
— Generally, the emphasis is not on credit training in the traditional sense, but rather on the achievement or mastery of a particular skill, procedure or instrument.
— The training format(s) must be flexible. This may require training on the shop floor, sharing of instructors and in-plant staff, sharing of equipment, and delivery in non-traditional time periods (e.g. nights and/or weekends). The rapidly changing state of the art dictates that there will always be a continuing need for retraining and upgrading.

In light of these considerations the critical question emerges. If the typical accreditation training stream is unable to respond to these particular industry-based needs, because of the institutions' broader educational responsibilities, then what type of quick-start process or organization does one propose to bridge this apparent gap?

Radically reshaping the present accreditation model does not appear feasible or indeed appropriate. Consequently, the answer appears to lie in the establishment of a new skill training mechanism or facility — at least in the Saskatchewan context.

In the previous section of this report, two existing but different training centres were discussed: Kanata High Technology Training Association and the Lorain County Community College's High Technology Training Centre. Obviously we agree with the reasoning from which arose the implementation chosen for Kanata and Lorain County. We were led inexorably to the conclusion that there is an urgent need to establish a new facility capable of responding to industrial needs for continual retraining of managers, technologists and technicians. We did not agree, however, that it was necessary in Saskatoon to adopt either the Kanata model of a separate institution for the retraining task, or the Lorain County model of a totally new physical facility associated with an existing college. We searched for an affordable solution.

The genesis of that solution emerged from our discussions. It was readily recognized that no one could reasonably expect that at all times the schools could have the most modern of all equipment. Yet because it must have them to remain competitive, industry does have the most appropriate, relevant, and modern equipment. Industry members have offered to make that equipment available in off-peak hours for

community training. Similarly, it was recognized that for certain training needs industry may have more capable teachers than the technical institutes. Again, industry members have offered to make instructors available for community training. Finally, it was recognized that there might in the future be a need for facilities which could be used for training, but also made available to industry on a shared basis. Thus there emerged from the discussions the concept of a separate division within Kelsey to conduct retraining programs for industry. Our conclusion in this matter is entirely consistent with the eighth 'principal finding' of the Parliamentary Task Force on Employment Opportunities for the '80s (House of Commons, 1982):

With an even more rapidly developing technology, it will be essential to have continuing education systems where individuals can train, retrain, and upgrade throughout their lives.

American data (American Association of Higher Education Bulletin, June, 1983) indicate that 85-90% of the labor force in 1990 is **already** working. Assuming similar circumstances in Canada, it is clear that retraining needs will match and likely exceed those of initial training by the end of the decade.

A "window" of opportunity exists in the high technology community in Saskatoon. The expanding critical mass of high technology firms appear supportive of a potential new partnership with existing institutions such as Kelsey, the universities and the Saskatchewan Research Council.

However, this window may close quickly if a meaningful partnership cannot be forged quickly. The environment appears ideal for a bold and decisive move. While the Task Force has not attempted to cost out the budgetary implications of its recommendations, the belief is that the necessary actions are not ones involving large sums of money or more bricks and mortar.

In summary, as the heading of this chapter suggests, the real challenge is the way in which the public sector chooses to manage its affairs in response to the needs of this particular industrial sector. Hesitancy, timidity and procrastination will clearly not suffice. Focused and directed change is what is required.

As the subsequent chapter on recommendations reveals, the Task Force has only modest suggestions respecting the expansion and/or creation of new programs in what we refer to as the accreditation stream. However, in the area of continuing education, retraining and upgrading the Task Force calls for an aggressive new facility for Saskatoon — a High Technology Centre. The following chapter expands on this particular proposal as part of its recommended strategy to Government.

Proposals and Recommendations

8.0 The Task Force through its survey questionnaire and interviews received a large number of recommendations and suggestions. This input was crucial in helping to shape the following recommendations. However, in formulating its advice to government, the Task Force was guided by a sense of wishing to be strategic in its approach and to point out broad new directions for consideration. Consequently, the report is not a definitive blue print for change, but represents a realistic and feasible plan of action. (In some instances very specific suggestions emanating from the Task Force's work have been forwarded directly to the Department for their consideration.)

Recommendation #1:

That the Government of Saskatchewan ensure that, to the extent possible, future high technology growth and development be concentrated in Saskatoon.

NOTE: The Task Force believes that while Saskatoon is currently the location for most of the province's high technology firms, the current environment is still very fragile. The required critical mass must continue to be nurtured in order to ensure a secure long term future. Only through a sufficient concentration of firms will the pattern for self-generation result. The Department of Advanced Education and Manpower, through Kelsey Institute and the University of Saskatchewan, must take a major role in providing the training, educational, and research support for this concentration of growth.

Recommendation #2:

That the Department of Advanced Eduction and Manpower establish two training streams at the Kelsey Institute of Applied Arts and Sciences — the current accreditation stream and a new continuing education or retrainng stream.

NOTE: The Task Force believes that by developing two specific training modes within the Institute the potential exists to enhance the accreditation programming when required and perhaps more importantly, establish a formal responsive capability to the training and upgrading needs of industry.

Recommendation #3:

That the Task Force recommends the elimination of the existing one year technician Chemical and Electronics programs, to be replaced by redesigned two year programs in the following areas: Electrical Engineering, Chemical Engineering, Computer Technology, and Micro-computer Technology.

NOTE: The findings of the Task Force have provided a clear indication that the graduate of Kelsey's current one year technician programs are often incapable of competing with graduates of two year programs offered in other provinces. The one year programs should be dropped if they cannot be extended to two years. Co-operative education should be seriously considered in the development of these new programs.

Recommendation #4:

That the Department of Advanced Education and Manpower establish a new High Technology continuing education unit or facility within Kelsey Institute.

NOTE: The Task Force believes there exists a special opportunity in Saskatoon to unite the interests of industry, education and science. A new High Technology Centre connected to Kelsey designed to be entrepreneurial in approach, collaborative with industry, and operated by a joint industry/education board would be an important first step in building on the shared commitment which currently exists. However, this opportunity for action has a short shelf life and hence positive results must

occur quickly. Accordingly, if requested, the members of the Task Force stand ready to participate in any subsequent process designed to elaborate on this High Technology Centre proposal.

While the Task Force has not presumed to define all of the Centre's characteristics, we do believe that the following must be central features:

— it must be headed by an assistant principal
— it should be directed by a joint institute-industry board
— it should be run in an entrepreneurial mode, responsive to the needs of Saskatchewan industry, and designed to be largely self sufficient in operating costs in about 5 years
— it should be concerned only with retraining needs and not those of initial qualifications
— it might assume some of the responsibilities for community general interest, applied science, training, and for general awareness programs aimed at the high school level
— it should be designed with the capacity to move rapidly to meet increasing demand from industry
— initial funding for such a Centre would come from government sources, with industry providing an increasingly large share of operating costs as the services expand.

We urge the Minister of Advanced Education and Manpower to act quickly on this opportunity. The need exists, the climate for cooperation is favorable, and federal government funds may well be available.

Recommendation #5:

That the Department of Advanced Education and Manpower undertake a comprehensive review of how current institute-based credit training is evaluated and recognized as entrance and/or prerequisite requirements in the province's universities.

NOTE: On many occasions the Task Force was urged to address the apparent inability, or at least extreme difficulty, that students with, for example, two year graduate certificates in the engineering technologies have in getting satisfactory recognition of this education when wishing to pursue a professional engineering degree.

The Task Force recommends that a transferability committee be established to ensure portability of two year technology programs. This committee would be chaired by a senior official from Advanced Education and Manpower and would have representatives from the two universities and the three technical institutes.

Recommendation #6:

That post secondary education facilities like Kelsey Institute explore new and innovative means of sharing equipment, facilities, and faculty.

NOTE: The Task Force believes that the public sector, particularly during times of fiscal restraint, cannot always provide the funds necessary to institutions like Kelsey to ensure that it has the equipment and facilities to prepare state-of-the-art graduates. This is particularly true of the high technology sector where the rapid change in equipment and its application dictates that students must have access to the latest facilities if they are to be competitive and employable upon graduation.

Recommendation #7:

That Government and industry expand their collaborative role in informing the public about the future of science and technology in our daily lives.

NOTE: During its work the Task Force became increasingly concerned about the limited extent to which the general role of science and technology in our society and its achievements are communicated to the public. The growth of scientific knowledge and the rate of technological change are not, in the Task Force's view, events to cause anxiety but rather should be viewed as opportunities for the future. In this regard more should be done to alert young people to these ensuing challenges and to more broadly inform the public about scientific progress and technological change.

Recommendation #8:

That the Department of Advanced Education and Manpower continue to review and monitor the data and statistical analysis contained in this report.

NOTE: The Task Force is confident that the survey methodology and analysis employed in this report have revealed, both in terms of magnitude and direction, the significance of the issues involved. However, the Task Force acknowledges the need to constantly review and update the data base because of the rapidly changing nature of the industry.

Recommendation #9:

That the Government of Saskatchewan establish an industry/government Advisory Council to further the opportunities for ongoing dialogue, advice and participation into public policy considerations affecting the high technology industry in Saskatchewan.

NOTE: The Task Force believes that there is a critical need to formalize an ongoing consultation process between the high technology industry and government. While perhaps beyond the mandate of this Task Force, we nevertheless are confident that a broadly based industry/government forum, equipped with a wide ranging mandate, would prove to be a useful device in furthering the interests of the government, the industry and the citizens of the province in this important industrial sector.

Recommendation #10:

That the Department of Advanced Education and Manpower establish a formal high tech industry/institute council at Kelsey Institute to pursue the suggestions and recommendations of this Task Force and to explore new opportunities for strengthening the interface between Kelsey Institute and the high technology community in Saskatoon.

NOTE: The Task Force is concerned that reports such as this one often lack the mechanism or process to provide impetus for subsequent action. We believe the desired changes proposed in this report are realistic and achievable, and because the opportunity exists now to effect meaningful change, the Task Force urges that a permanent high tech industry/institute council be established to assist Kelsey Institute in the implementation of the Task Force recommendations.

APPENDIX A
High Technology Task Force Survey
Formal Interviews Providing Quantitative Data

Private Sector:

Dr. D.B. Barnett, Director
Canadian Centre for Advanced Instrumentation
Room 124 SEDCO Centre
Saskatoon, Saskatchewan

Mr. Jerry Bissett, Personnel Director
SED Systems Inc.
2305 Koyl Avenue
Saskatoon, Saskatchewan

Dr. Ralph Cheeseman, Executive Director
Saskatchewan Mining Association
730 Avord Towers
Regina, Saskatchewan

Mr. Glenn Driscoll, President
Borealis Systems Limited
P.O. Box 8638
Saskatoon, Saskatchewan

Mr. Jim Figley, President
Spectron Computer Corporation
41 - 1736 Quebec Avenue
Saskatoon, Saskatchewan

Mr. Perry Foster, President
Industrial Machine and Manufacturing Ltd.
805 Circle Drive East
Saskatoon, Saskatchewan

Mr. Imry Gombos, Director of Manufacturing
Northern Telecom Limited
P.O. Box 807
Saskatoon, Saskatchewan

Mr. Yves Gosselin, Director of Human Resources
Northern Telecom Limited
P.O. Box 807
Saskatoon, Saskatchewan

Ms. Anita Hogan, Personnel Director
Prince Albert Pulp & Paper Corporation
Prince Albert, Saskatchewan

Dr. Dennis Jones
Executive Director
POS Pilot Plant Corporation
118 Veterinary Road
University of Saskatchewan
Saskatoon, Saskatchewan

Mr. Gene Kotelko, Director
Human Resources and Training
Develcon Electronics Limited
856 - 51st Street East
Saskatoon, Saskatchewan

Mr. Ken Lamb
Sci-Tech Instruments Limited
222 Cardinal Crescent
Saskatoon, Saskatchewan

Mr. Kelvin Menzies, Training Director
Potash Company of America
P.O. Box 509
Saskatoon, Saskatchewan

Mr. Jack Miller, Personnel Officer
Co-op Refinery Limited
Winnipeg Street
Regina, Saskatchewan

Mr. Heinrich Oswald, President
Oswald Gear and Machine
806B - 59 Street East
Saskatoon, Saskatchewan

Mr. G. Paulson, General Manager
Startco Engineering Ltd.
406 Jessop Avenue
Saskatoon, Saskatchewan

Mr. Brian Pickett
Superior Hard Chrome Inc.
3235 Millar Avenue
Saskatoon, Saskatchewan

Ms. Maggie Rankin, Training Supervisor
Co-operators Insurance Limited
1920 College Avenue
Regina, Saskatchewan

Mr. Greg Rideout, Plant Manager
AEL Microtel Limited
2610 Koyl Avenue
Saskatoon, Saskatchewan

Mr. Barry Robson, Manager
Electronics Department
Smith-Roles Ltd.
2401 Millar Avenue
Saskatoon, Saskatchewan

Mr. Morton Satin, President
Pro Star Mills Ltd.
817 - 48th Street East
Saskatoon, Saskatchewan

Mr. Bill Strelioff, Owner
Senstek Ltd.
P.O. Box 340
Saskatoon, Saskatchewan

Mr. Jack Venables, President
Venables Machine Works Limited
502 - 50th Street East
Saskatoon, Saskatchewan

Mr. Bob Virgo, Director
Data Centre
Saskatchewan Wheat Pool
2625 Victoria Avenue
Regina, Saskatchewan

Mr. S. Walker, General Manager
Prairie Data Systems
202 - 626 Broadway Avenue
Saskatoon, Saskatchewan

Public Sector:

Dr. J. Bergsteinsson
Saskatchewan Research Council
30 Campus Drive
University of Saskatchewan
Saskatoon, Saskatchewan

Mr. C.H. Bigland, Director
Veterinary Infectious Diseases Organization
124 Veterinary Road
University of Saskatchewan
Saskatoon, Saskatchewan

Mr. Alfred Boryki, Head
Operations Division
Sask. Comp
SEDCO Centre
P.O. Box 384
Saskatoon, Saskatchewan

Dr. H.S. Caplan, Director
Saskatchewan Accelerator Laboratory
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. Bruce Cooke, Dean
College of Engineering
University of Regina
Regina, Saskatchewan

Mr. Jan Gustafson, Director
Traffic Control & Radio Communications
City of Saskatoon
City Hall
Saskatoon, Saskatchewan

Dr. Bryan Harvey, Head
Crop Development Centre
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. J.R. Hay, Director
Agriculture Research Station
Agriculture Canada
107 Science Crescent
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. T.J. Pepper, President
Saskatchewan Research Council
30 Campus Drive
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. H.B. Scheifer, Director
Toxicology Centre
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. W.F. Steck, Director
Biotechnology Institute
National Research Council
110 Gymnasium Road
University of Saskatchewan
Saskatoon, Saskatchewan

Mr. Roy Taylor
Training and Development Officer
Saskatchewan Power Corporation
2025 Victoria Avenue
Regina, Saskatchewan

Mr. Peter Van Vliet, Vice President
Network Services
Saskatchewan Telecommunications
2350 Albert Street
Regina, Saskatchewan

Mr. Gordon Westley, Manager
Prairie Swine Centre
University of Saskatchewan
Saskatoon, Saskatchewan

APPENDIX B
Informal Interviews Providing Qualitative Data

Mr. John Alderman, Director
Occupational Health and Safety Branch
Saskatchewan Health
TC Douglas Building
Regina, Saskatchewan

Mr. Ken Alexe
Labour Market Planning and
Information Branch
Department of Advanced Education
& Manpower
1855 Victoria Avenue
Regina, Saskatchewan

Mr. Bill Conrod, Dean
Continuing Education
Algonquin College
Ottawa, Ontario

Mr. Larry Dinter, Assistant Principal
Kelsey Institute of Applied Arts and Sciences
Saskatoon, Saskatchewan

Dr. Walter Edling, Dean of Instruction
Lorain County Community College
Lorain County, Ohio

Mr. Dave Fairlie, Director
Industrial Development Branch
City of Saskatoon
Saskatoon, Saskatchewan

Mr. Dan Gallant, Manager
Toronto Dominion Bank
410 - 22nd Street East
Saskatoon, Saskatchewan

Mr. Dave Garner, Manager
Data Centre
Toronto Dominion Bank
Regina, Saskatchewan

Mr. Dallas Garrett, Division Chairman
Engineering and Computer Technologies
Lorain County Community College
Lorain County, Ohio

Dr. Alex Guy, Acting Deputy Minister
Department of Telephones
TC Douglas Building
Regina, Saskatchewan

Dr. Steve Hardy, Professor
College of Engineering
University of Regina
Regina, Saskatchewan

Mr. Frank Hector
Sci-Tech Instruments Ltd.
222 Cardinal Crescent
Saskatoon, Saskatchewan

Mr. James Hill, Director
High Technology Training Centre
Lorain County Community College
Lorain County, Ohio

Dr. Blaine Holmlund, Vice President
Special Projects
225 Administration Building
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. Leon Katz
203 Bell Crescent
Saskatoon, Saskatchewan

Ms. Susan Lafleur, Program Manager
Kanata High Technology Training Association
Kanata, Ontario

Dr. Derek Lane-Smith, President
Waterloo Centre for Creative Technology
Waterloo, Ontario

Mr. Robert Long, Executive Director
Canadian Advanced Technology Association
Ottawa, Ontario

Mr. Ivan McArther
Biological Sciences Department
Kelsey Institute of Applied Arts and Sciences
Saskatoon, Saskatchewan

Mr. R.J. McKenzie, Incentives Officer
Dept. of Regional Economic Expansion
601 Spadina Crescent East
Saskatoon, Saskatchewan

Mr. C.A. McPherson, Chairman
Electricity/Electronics
Algonquin College
Ottawa, Ontario

Mr. Bob Naphin
Applied Sciences Division
Kelsey Institute of Applied Arts and Sciences
Saskatoon, Saskatchewan

Mr. Michael Nolan, Director
Corporate Training
Mitel Corporation
Kanata, Ontario

Mr. James Nyman, Director
Technology and Trades — Continuing Education
Algonquin College
Ottawa, Ontario

Mr. Gordon Pierce, Manager
Product and Process Development
Saskatchewan Research Council
SEDCO Centre
University of Saskatchewan
Saskatoon, Saskatchewan

Dr. R.C. Quittenton, Executive Director
SEDCO Innovation Place
1000 - 241 2nd Avenue South
Saskatoon, Saskatchewan

Mr. Stuart Ross, Dean
Trades and Technology Division
Algonquin College
Ottawa, Ontario

Mr. Ron Smith, President
Association of Engineering Technicians and Technologists of Saskatchewan
c/o BBT Engineering Consultants
608 McLeod Street
Regina, Saskatchewan

Mr. Gordon Sparks
Sparks, Duffee and Associates
Consulting Engineers
2220 Avenue C North
Saskatoon, Saskatchewan

Dr. John Spinks
180 Thorvaldson Building
University of Saskatchewan
Saskatoon, Saskatchewan

Mr. Murray Strankay
Applied Sciences Department
Kelsey Institute of Applied Arts and Sciences
Saskatoon, Saskatchewan

Mr. Graeme Strathdee, Manager
Research and Development Planning
Potash Corporation of Saskatchewan
410 - 22nd Street East
Saskatoon, Saskatchewan

Mr. Jim Sweezie, President
Kanata High Technology Training Association
Kanata, Ontario

Mr. Ian Thomas, Director
Labour Market Planning and Information Branch
Department of Advanced Education & Manpower
1855 Victoria Avenue
Regina, Saskatchewan

Mr. A. Verma, Director
Research and Development
1436 - 300 5th Avenue S.W.
Calgary, Alberta

Mr. Trevor Williams
Applied Sciences Department
Kelsey Institute of Applied Arts & Sciences
Saskatoon, Saskatchewan

APPENDIX C
High Technology Industry Survey Raw Data—Private Sector

Total Number of Employees	Number of High Tech Employees			Classification of Employees				Number of Employees Trained in Saskatchewan			
	Full Time	Part Time	Lay Worker	Technician	Technologist	Professional	Other	Technician	Technologist	Professional	Other
10	10	0	2	0	5	3	0	0	5	3	0
30	24	0	5	0	9	8	2	0	8	8	2
10	10	0	0	0	2	8	0	0	0	8	0
16	12	4	6	3	1	6	0	3	1	6	0
36	4	0	4	0	0	0	0	0	0	0	0
14	14	0	9	5	0	0	0	5	0	0	0
23	19	0	4	1	6	9	0	0	9	9	0
17	2	15	0	1	0	1	0	0	0	0	0
13	7	0	1	0	3	3	3	0	2	3	0
150	12	0	8	1	1	2	0	1	1	2	0
	17	0	0	0	10	7	0	0	10	5	0
12	3	0	1	0	1	1	0	0	1	1	0
20	9	0	4	0	1	3	0	0	1	4	0
7	6	0	1	2	3	1	0	2	2	0	0
438	91	0	70	6	0	15	0	4	0	15	0
282	193	0	49	14	75	54	–	12	56	38	0
178	109	0	43	0	24	42	0	0	24	42	0
155	123	0	100	7	10	6	0	7	10	4	0
110	110	0	45	15	10	40	0	15	10	30	0
5	5	0	0	0	0	6	0	0	0	1	0
290	100	0	60	10	5	25	0	10	5	20	–
425	425	20	230	12	47	163	0	11	35	122	0
2,454	1,306	39	642	77	213	494	5	70	176	321	2

APPENDIX D

High Technology Industry Survey Raw Data—Public Sector

Total Number of Employees	Number of High Tech Employees			Classification of Employees				Number of Employees Trained in Saskatchewan			
	Full Time	Part Time	Lay Worker	Technician	Technologist	Professional	Other	Technician	Technologist	Professional	Other
29	15	11	2	0	6	8	0	0	1	1	0
15	8	3	0	0	8	3	0	0	7	3	0
6	6	0	0	1	2	3	0	1	2	1	0
13	9	0	0	0	0	2	7	0	0	2	7
6	6	0	0	2	2	2	0	1	1	2	0
32	30	0	10	1	0	19	0	1	0	19	0
38	38	0	6	0	19	10	0	0	13	10	0
190	184	6	30	11	28	105	16	11	21	44	16
96	68	0	0	0	14	43	0	0	14	10	0
106	61	45	0	0	35	26	45	0	34	20	45
107	97	10	23	0	37	37	0	0	37	30	0
4,767	2,064	0	1,396	117	400	151	0	13	110	113	0
2,700	569	0	150	0	150	269	0	0	148	200	0
8,105	3,155	75	1,617	132	701	678	68	27	388	455	68

APPENDIX E

Observations of the High Technology Industry Regarding Content and Delivery of Current Kelsey Programs

— One year technician training programs do not adequately prepare individuals for positions with the high technology industry. Chemical Technician and Electrical/Electronics Maintenance and Repair would be much more valuable if they were two or three years in duration.

— Basic aptitude and attitude are key factors when choosing employees. New graduates know little about the local firms who are prospective employers.

— Computer programming and data processing prefer individuals with a great deal of practical experience. Industry stresses a heavy emphasis on developing practical skills in training programs in all areas of high technology.

— The biotechnology industry is currently concentrating on research and development. It prefers individuals with a sound theoretical background and a working knowledge of basic research techniques, methods and attitudes.

— The pulp and paper, and mining industries are requesting that the Electrical/Electronics Maintenance and Repair (EEMR) Program be increased to a two year program which includes a common first year comprised of core classes with a choice of options for specialization in the second year of the program. An apprenticeship program in the area of specialization would be a valuable addition which would also increase the level of practical skill development.

— The current tight economic conditions are forcing firms, especially smaller firms, to hire an increased number of generalists rather than those with very specifically refined skills. It is the general consensus that the return of freer economic conditions will increase the demand for people trained in highly specialized areas. Saskatoon is considered to be an excellent location for recruiting staff at present.

— Highly specialized professionals are difficult to obtain in the advanced biotechnology area.

— There is a great shortage of individuals with under-graduate and graduate degrees in Computer Science and Data Processing.

— Internships and apprenticeships are highly supported by the entire high technology industry. They give students a feel for the actual expectations of industry and provide them with an opportunity to work with modern up-to-date equipment in a productive manner. There was an overall support for co-operative programming with the greatest co-opertion being exhibited in providing instructors and internships as opposed to facilities for training. Four months was suggested as the minimum length of time for which an internship could be thought of as productive to the company and at the same time, a valuable learning experience for the student.

— Advisory councils composed of high level industry and government representatives are an essential tool for tailoring programs to meet the long term needs of industry. Such councils have an invaluable role in advising post secondary institutions regarding the desirability of and practicality of continuing education programs.

— Basic computer orientation would be a valuable addition to most programs.

— Saskatchewan Power Corporation currently trains its own "power engineers" and would enthusiastically support the implementation of this program with the technical institutes. They estimate that they would be able to utilize on average, about twenty (20) "power engineers" per yeer.

— Short courses are required in the following areas:

i) Integrated circuitry;
ii) Quality control (testing procedures);
iii) First line management skills;
iv) CAD/CAM to update present staff;
v) Conversion to metric;
vi) Other courses at the leading edge of technology.

— The concept of accredited courses being offered in modular form during non-working hours so that an individual could obtain a university degree or a technical institute diploma was supported by all sectors of the high technology industry.

— The City of Saskatoon and the Potash Company of America would enroll thirty people immediately in the EEMR Program if it were offered in a modular format on non-working hours.

— Changes in technology in the pulp and paper and the mining industries are expected to occur at a slower pace than in other industries.

— Biotechnology is expected to experience the greatest level of growth in the future. Its application to our large agricultural sector is the main reason for this expectation.

— Considerable in house training is occurring in industry as a result of the failure of the institutions to adapt to the needs of industry. Many of these programs would be discontinued if valuable and relevent programs at the leading edge of technology were available in educational institutions.

— There is a need to update current staff rather than hire new staff. Many firms believe that this should be the major concern of the technical institutes within the province. It has been suggested that institute staff be encouraged to attend workshops on new equipment and technology which are offered by the manufacturers of this equipment.

ERIC Clearinghouse for Junior Colleges
8118 Math-Sciences Building
University of California
Los Angeles, California 90024

APR 12 1985